

solutions and methods for expressing the concentration

solution: is a homogenous mixture consisting of  
 solute (small amount) dissolved in solvent (Large amount)

★ Excption ★ الماء مذيب (aqueous solution) حتى وان كان بكمية أقل  
 $H_2O$  in (9g) = solvent ← يعني

★ mass of solution = mass of solute + mass of solvent.

★ volume " " = volume " " + volume " "

Example (1):

to prepare NaCl solution  
 If 6.0 g of NaCl was dissolved in 50 g of  $H_2O$  (which  
 is solute, solvent, solution?)

solution

mass of NaCl = 6 g → solute (small amount)

mass of  $H_2O$  = 50 g → solvent (large amount)

mass of NaCl solution = mass of NaCl + mass of  $H_2O$

$$= 6 \text{ g} + 50 \text{ g} = 56 \text{ g}$$

Example (2):

If 6.0 g of NaCl dissolved in sufficient ( $H_2O$ ) to  
 prepare NaCl solution. what the mass of ( $H_2O$ )  
 (56g) solution?

$$m_{\text{solution}} = m_{\text{NaCl}} + m_{\text{H}_2\text{O}}$$

$$m_{\text{H}_2\text{O}} = m_{\text{NaCl solution}} - m_{\text{NaCl}}$$

$$= 56 - 6 = 50 \text{ g} \quad \boxed{\text{if mass } H_2O = 50 \text{ g}}$$



## \* Qualitative Expression of Concentration -

هناك طريقتان للتعبير عن تركيز المحلول .

1- dilute solution  
small amount of solute  
relatively to solvent

2- concentrated solution  
large amount of solute  
relative to solvent

## \* semi-quantitative expression of concentration -

هناك ثلاث طرق للتعبير عن المحلول ((كمياً)).

1- unsaturated  
small amount of solute  
less dissolved  
relatively to  
capable

2- saturated  
maximum amount  
of solute  
relatively  
to capable

3- super-saturated  
more amount  
of solute  
relatively to capable

## Electrolyte and non-electrolyte - solution -

1) electrolyte: dissolved in solvent <sup>and</sup> form charged particles  
 $\text{NaCl} \xrightarrow{\text{H}_2\text{O}} \text{Na}^+ + \text{Cl}^-$  يكون محلولاً يوصف بالأيوني

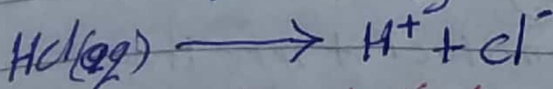
2- non-electrolyte: dissolved in solvent and form uncharged particles.

\* sugar  $\xrightarrow{\text{H}_2\text{O}}$  sugar solution. يكون محلولاً يوصف بالغير أيوني

## electrolyte

### strong electrolyte

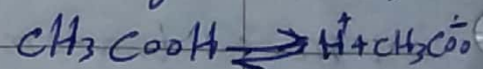
completely ionizing



irreversible غير عكسي

### weak electrolyte

partly ionizes



reversible عكسي

## methods for expressing the concentration

1- strength ~~of~~ of solution (S): The number of grams of solute in 1L of solvent (g/L)

$$S = \frac{\text{mass of solute (g)}}{\text{volume of solution (ml)}} \times 1000 \quad \text{g/ml}$$

or 
$$S = \frac{\text{mass of solute (g)}}{\text{volume of solution (L)}}$$

example:-

The concentration of NaCl solution is 0.5 g/L what it's meaning means:

0.5 g of NaCl present in 1L from NaCl solution.

## 2- percentage methods:-

A) percent by mass (w/w): The mass of solute in 100g of solvent

$$\% (w/w) = \frac{\text{mass of solute g}}{\text{mass of solution g}} \times 100 \%$$

example (1)

The concentration of NaCl solution is 10% (w/w) what meaning that.

meaning that 10 g of NaCl present in 100 g of H<sub>2</sub>O → (10g NaCl)

or 10 g of NaCl present in 100 g of NaCl solution

example (2): when certain amount of Na<sub>2</sub>SO<sub>4</sub> was dissolved in H<sub>2</sub>O to prepare 200g of a 60 (w/w) Na<sub>2</sub>SO<sub>4</sub> solution.

calculate the mass of Na<sub>2</sub>SO<sub>4</sub> and H<sub>2</sub>O?

$$m_{\text{Na}_2\text{SO}_4 \text{ sol}} = 200 \text{ g} \quad (w/w)\% = \frac{\text{mass Na}_2\text{SO}_4 (g)}{\text{mass Na}_2\text{SO}_4 \text{ sol} (g)} \times 100 \%$$

$$\Rightarrow 60\% = \frac{\text{mass of Na}_2\text{SO}_4 (g)}{200 \text{ g}} \times 100 \%$$

$$\text{mass Na}_2\text{SO}_4 = \frac{60 \times 200 \text{ g}}{100} = 120 \text{ g}$$

$$\text{mass of H}_2\text{O} = \text{mass Na}_2\text{SO}_4 \text{ sol} - \text{mass of Na}_2\text{SO}_4 \\ = 200 \text{ g} - 120 \text{ g} = 80 \text{ g}$$

B) Percent by mass per volume (w/v): The mass of grams of solute in 100 ml of solution (% w/v)

$$\% (w/v) = \frac{\text{mass of solute (g)}}{\text{volume of solvent}} \times 100\%$$

~~C) Percent by~~ Example (1)

A 12.7 g of  $\text{H}_2\text{SO}_4$  was dissolved in 199.3 g of  $\text{H}_2\text{O}$  to prepare  $\text{H}_2\text{SO}_4$  solution. density of  $\text{H}_2\text{SO}_4$  soln is 1.06 g/ml at 25°C. Calculate:

- ① The percent of  $\text{H}_2\text{SO}_4$  in (w/w)
- ② " " " " " (w/v)
- ③ The strength of  $\text{H}_2\text{SO}_4$  solution.

solution

$$\text{mass of solute} = 12.7 \text{ g} \quad \text{mass of solvent} = 199.3 \text{ g}$$

$$\text{mass of } \text{H}_2\text{SO}_4 \text{ solution} = 12.7 + 199.3 = 212 \text{ g}$$

$$\text{① percent in (w/w)} \% = \frac{\text{mass of solute (g)}}{\text{mass of solution (g)}} \times 100\%$$

$$\text{② percent in (w/v)} \% = \frac{12.7}{212} \times 100\% = 5.99\%$$

$$\text{or } d = \frac{m}{V} \Rightarrow V = \frac{m}{d} = \frac{212 \text{ g}}{1.06 \text{ (g/ml)}} = 200 \text{ mL}$$

$$\text{③ } (w/v)\% = \frac{12.7}{200} \times 100\% \Rightarrow (w/v)\% = 6.35\%$$

$$\text{③ } S = \frac{\text{mass of } \text{H}_2\text{SO}_4}{\text{Volume of } \text{H}_2\text{SO}_4 \text{ sol}} = \frac{12.7 \text{ (g)}}{200 \text{ mL} \times 1000} \times 1000 = 63.5 \text{ g/L}$$

12/10/2021

مسألة الواجب

مسألة الواجب

When 6.0 g of NaCl was dissolved in H<sub>2</sub>O to prepare 72 g of NaCl solution. The density of NaCl solution 1.21 g/ml calculate:-

- ① the percent NaCl in (w/w)
- ② " " " " (w/v)
- ③ strength of NaCl solution.

solution

- mass of NaCl (solute) = 6 g / mass of H<sub>2</sub>O = ?? (solvent)  
 - mass of NaCl solution = 72 g / d of NaCl soln = 1.21 g/ml  
 w/w = ??      w/v = ??      S = ??

→ mass of H<sub>2</sub>O = mass NaCl sol - mass of NaCl  
 mass of H<sub>2</sub>O = 72 - 6 = 66 g

$$1. (w/w)\% = \frac{\text{mass of solute (NaCl) g}}{\text{mass of solution g}} \times 100\% \\ = \frac{6}{72} \times 100 = \boxed{8.33\% \text{ w/w}}$$

$$2. (w/v)\% = \frac{\text{mass of NaCl (g)}}{\text{volume of NaCl solution (mL)}} \times 100\% \\ \therefore d = \frac{m}{V} \quad \therefore V = \frac{m}{d} = \frac{72}{1.21} = \boxed{59.5 \text{ mL}}$$

$$\therefore (w/v)\% = \frac{6 \text{ g}}{59.5 \text{ mL}} \times 100\% = \boxed{10.08\% \text{ w/v}}$$

$$3. S = \frac{\text{mass of solute (g)}}{\text{volume solution (mL)}} \times 1000 = \frac{6 \text{ (g)}}{59.5} \times 1000 = \boxed{100.8 \text{ g/L}}$$